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Review

Spectroscopic diagnostics of a strongly inhomogeneous optically thick plasma. Part 1. The formation of asymmetric self-reversed emission and absorption lines: determination of electron impact half-width and electron concentration

I.S. Fishman, G.G. Il'in, M.Kh. Salakhov*

Department of Physics, Kazan State University, Kazan, Tatarstan 420008, Russia

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Abstract

An analysis has been carried out of the profiles of asymmetrically self-reversed emission lines and of absorption lines using various models for inhomogeneous optically thick plasmas. Conditions of impulsing discharge, exploding wires, sparks, plasma jets, laser ablation of a target, etc. were considered. The possibility of determining electron impact half-width and electron concentration from the wings of asymmetrically self-reversed lines is considered.

Keywords: Plasma; Self-reversed line

1. Introduction

Numerous plasma light sources, such as those associated with impulsing discharges, exploding wires, sparks, plasma jets, flares (laser-produced plasma), formed when laser radiation interacts with a substance (e.g. during metal welding and cutting) may be classed as optically thick plasmas with a strongly inhomogeneous structure. The inhomogeneity is reflected in the spatial gradient of the temperature, the atom and electron concentrations and in the variation of spectral line Doppler shift, related to the component of atom and ion streaming velocity in the direction of the line-of-sight. The inhomogeneity of an optically thick plasma is reflected in the formation of strongly asymmetric self-reversed emission lines, together with asymmetric absorption lines having a deep trough in the middle and line wings asymmetric to the frequency ν_{min} at which the intensity of the self-reversal is minimal.

* Corresponding author.

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